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AMENDMENT

In the Claims

Please amend the claims as follows:

1. (Amended) A method for modifying a virtual object in a haptic virtual environment, comprising:

determining a virtual tool comprising a plurality of discrete points for use by the user in the haptic virtual environment;

selecting a modification mode other than a surface deformation for the virtual tool;

sensing a location of a user in real space;

determining locations of the plurality of discrete points of the virtual tool relative to a location of the virtual object;

calculating an interaction force between the virtual tool and the virtual object based on the locations of the plurality of discrete points of the virtual tool and the location of the virtual object;

producing a modified virtual object by modifying the virtual object based on the modification mode, the locations of the plurality of discrete points of the virtual tool and the location of the virtual object; and

outputting the modified virtual object.

6. (Amended) The method of claim 1, wherein the step of selecting a modification mode for the virtual tool comprises selecting at least one of a material removal mode, a material addition mode, a smoothing mode, a mirroring mode, and a 3-D sketch [material modification] mode.

10. (Amended) A system for modifying a virtual object by a user in a haptic virtual environment, the system comprising:

a virtual tool comprising a plurality of discrete points for use by the user in the haptic virtual environment, wherein the user selects a modification mode for the virtual tool other than a surface deformation;

a haptic interface device, wherein the haptic interface device senses a location of the user

in real space;

a modeling application in communication with the haptic interface device, the virtual object, and the virtual tool, wherein the modeling application determines locations of the plurality of discrete points of the virtual tool relative to a location of the virtual object; calculates an interaction force between the virtual tool and the virtual object based on the locations of the plurality of discrete points of the virtual tool and the location of the virtual object; produces a modified virtual object by modifying the virtual object based on the modification mode; the locations of the plurality of discrete points of the virtual tool, and the location of the virtual object; and outputs the modified virtual object.

15. (Amended) The system of claim 10, wherein the modification mode is a selected one of a material removal mode, a material addition mode, a smoothing mode, a mirroring mode, and a 3-D sketch [material modification] mode.

19. (Amended) A method for interfacing with a voxel-based virtual object in a haptic virtual environment, comprising:

generating a voxel-based virtual object comprising a virtual surface in the haptic virtual environment;

setting a constraint geometry in the haptic virtual environment;

determining a virtual tool for use by the user in the haptic virtual environment;

sensing a location of a user in real space;

determining a haptic interface location in the haptic virtual environment in response to the location of the user in real space;

determining a position of the virtual tool in the haptic virtual environment in comparison to the haptic interface location and the location of the virtual surface and the constraint geometry;

constraining an action of the virtual tool based on (i) the constraint geometry, (ii) the virtual surface, (iii) the position of the virtual tool, and (iv) the haptic interface location.

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22. (Amended) The method of claim 19, further comprising the step of modifying the voxel-based virtual object based on the position of the virtual tool.

23. (Amended) The method of claim 19, further comprising calculating an interaction force among the constraint geometry, the voxel-based virtual object, and the virtual tool in response to the step of determining the position of the virtual tool.

24. (Amended) The method of claim 19, further comprising the steps of selecting a modification mode for the virtual tool, and modifying the voxel-based virtual object in response to the modification mode and the position of the virtual tool.

27. (Amended) A system for interfacing with a voxel-based virtual object in a haptic virtual environment, the system comprising:

a voxel-based virtual object comprising a virtual surface;

a virtual tool for use by the user in the haptic virtual environment;

a constraint geometry limiting the movement of the virtual tool in the haptic virtual environment;

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a haptic interface device, wherein the haptic interface device senses a position of the user in real space;

a modeling application in communication with the haptic interface device, the voxel-based virtual object, and the virtual tool, wherein the modeling application determines a haptic interface location in the haptic virtual environment in response to the location of the user in real space; determines a position of the virtual tool in the haptic virtual environment in comparison to the haptic interface location, and the location of the virtual surface and the constraint geometry; and constraining an action of the virtual tool based on (i) the constraint geometry, (ii) the virtual surface, and (iii) the position of the virtual tool, and (iv) the haptic interface location.

30. (Amended) The system of claim 27, wherein the modeling application modifies the voxel-based virtual object based on the position of the virtual tool.

31. (Amended) The system of claim 27, wherein the modeling application calculates an interaction force among the constraint geometry, the voxel-based virtual object, and the virtual tool in response to determining the position of the virtual tool.

32. (Amended) The system of claim 27, further comprising a modification mode for the virtual tool selected by the user, and the modeling application modifies the voxel-based virtual object in response to the modification mode and the position of the virtual tool.

Please add new claims as follows:

35. (New) The method of claim 1, wherein the virtual object comprises a voxel-based virtual object.

36. (New) The system of claim 10 wherein the virtual object comprises a voxel-based virtual object.

RESPONSE

Prior to entry of this Amendment and Response, claims 1-34 are pending in the Application. Claims 1-34 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,191,796 to Tarr (hereinafter "Tarr"). Applicants have amended independent claims 1 and 10 to recite "modifications other than surface deformations." Applicants have amended claims 6 and 15 to recite "a modification mode for the virtual tool comprises selecting at least one of a material removal mode, a material addition mode, a smoothing mode, a mirroring mode, and a 3-D sketch mode." Applicants have amended independent claims 19 and 27 to recite a "voxel-based virtual object." Applicants have amended the terminology of dependent claims 22-24 and 30-32 to properly depend from amended claims 19 and 27, respectively. Applicants have added new dependent claims 35 and 36, which depend from claims 1 and 10, respectively, and that recite a "voxel-based virtual object." Support for the amendments may be found throughout the Specification and Drawings and particularly at page 19, lines 22-26, page 20, lines 15-22, page 22, line 20 through page 21, line 17, and page 29, line 1 through page 34,

line 26. No new matter has been added by these amendments. Following entry of the present Amendment, claims 1-36 are pending in the Application.

Applicants wish to thank Examiner Santiago for his helpful suggestions and recommendations during the telephonic interview on March 19, 2002, during which interview there was a discussion of the Tarr reference and possible amendments to the claims. Applicants respectfully submit that this paper is consistent with the discussion therein.

Rejection of Claims 1-34 under 35 U.S.C. §102(e)

Claims 1-34 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Tarr. Tarr discloses surface modifications of virtual objects, including plastic and visco-elastic deformations of virtual surfaces. For example, see the Abstract of Tarr, Figure 1B of Tarr, and the disclosure of Tarr at column 1 lines 7-12, column 2, lines 2-33, and column 5, line 11 through column 10, line 43. Tarr does not appear to expressly disclose a virtual object that is represented other than as a surface. Tarr uses the term "voxel" with regard to the three dimensional nature of a virtual tool having a volume, for example at column 14, lines 4-32, page 16, line 30 through column 17, line 8, and column 19, lines 17-53. However, Tarr does not describe the virtual surface, a two dimensional construct, in terms of voxels, which are a three dimensional construct. See Tarr's discussion of voxels at column 16, lines 52-66. Therefore, Tarr fails to expressly disclose the interaction of a voxel-based virtual object with a virtual tool, nor does Tarr expressly disclose modifications of a virtual object other than surface modifications.

Applicants respectfully submit that claims 1-36 are patentable over Tarr, because Tarr fails to disclose every limitation of claims 1-36.

In view of the forgoing, Applicants respectfully request that the rejection of claims 1-34 under 35 U.S.C. §-102(e) be reconsidered and withdrawn. Applicants respectfully submit that claims 1-36 are now in condition for allowance.